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CONTENTS

GDR, USSR COOPERATE IN FIBEROPTIC RESEARCH

East Berlin DER MORGEN in German 24 Jan 80 p 5

[Article by Phillip von Wilcke: "Laser Light in the Telephone Cable--30,000 Conversations Over One Pair of Lines--USSR and GDR Have Developed a New Laser Source"]

[Text] Beams of light as communication connections are under increasing discussion. Telephoning by laser or TV reception of special educational programs via glass fiber cables no longer seem to be remote visions of the future. Everyone knows the problem and we meet it all over the world: the existing transmission networks and their cables and radio wavelengths are overloaded and can no longer be expanded significantly. The general availability of telephones to the population, in addition to television and radio, contribute considerably to this.

The solution advocated most recently is called optoelectronics. Reliance on the technical alternative is based on different successful developments and experiments on which scientists in our country are cooperating with those in the Soviet Union. The academy of the Central Institute for Optics and Spectroscopy in Berlin, Adlershof, jointly developed a semiconductor laser system with the Physical Institute of the Academy of Sciences of the USSR whose technical parameters afford good possibilities for information transmission. In theory, thousands of conversations or a corresponding number of other bits of information can be transmitted simultaneously in a light transmission channel.

Standard light sources are eliminated in advance since coherent wave trains of constant frequency are needed, just like those needed for a radio transmitter. Only laser light sources meet these demands and can also be highly bundled. For instance, in the Soviet-French experiments on the earth-moon path, the light beam had scattered to a diameter of only about 1.5 km upon reaching the moon.

Of the different types of lasers available since about 1960, the semiconductor laser, also called laser diode, is important for communications technology. It converts electrical current directly into laser light which can be very easily imprinted with the appropriate information, music, etc. Dr Hans-Jurgen Bachert, director of the research collective at the Academy

Institute explains: "The laser diode contains a small crystal with one tiny interesting region in which the leaser beam is generated. This region is about 1,000 times smaller than a human hair."

This minuteness of the research object gives an impression of the difficulties which are primarily of a technological nature. Therefore, scientists from the GDR and USSR initially built a larger model on which to study optic-geometric problems. Initially, the lasers had to be operated at -126°C, but today they do not need to be cold.

Laser technology is to be harnessed for information transfer to an optic effect known for many decades: light can be "barricaded" in a sheathed glass filament and conducted even along curved paths. It is thereby constantly reflected and transits the conductor in a zig-zag motion. Two glass fibers the thickness of the skin permit the transmission of about 30,000 telephone conversations, whereas a pair of standard lines are able to carry only 24 conversations.

Not long ago the partners of the GDR scientists--the Physical Institute of the Soviet Academy of Sciences and the Institute for Radio Technology of the USSR--presented several models of such lines to the public: a superthin glass fiber in a simple polyethylene sheath. The lines could be easily bent and even tied in knots. An optimum cable of only 13 mm diameter is able to do just as much as a multiple-wire, copper cable as thick as an arm. The problem here is also a technological one: we need glass fibers of the smallest diameter which cannot be much larger than the wavelength of the radiation.

The glass fiber used at the beginning of the year in the first successful TV light cable transmission in Poland was only 0.15 mm thick. The large image transferred from the TV camera to the monitor did not differ in color, contrast or detail from that obtained from the usual thick, heavy metal cable.

Naturally, there are still numerous problems to be resolved before large scale introduction of a new communications connection. For instance, laser light is significantly attenuated in the line and it requires small, high performance amplifier stations at intervals of a few kilometers. Tests are proceeding on the difficult connection and branching of glass fiber lanes. Here we obtain not only the obvious advantage that one gram of glass can replace 10 kg of expensive copper in laser glass fiber transmissions; furthermore, there is no lack of raw materials for glassmaking so that the great promise of this technology will be illuminative from an additional viewpoint.

PHOTO CAPTIONS

1. p 5. The tiny zone for the generation of laser light in an appropriate diode; the radiation forms at the interface between semiconductor block and carrier material.

2. p 5. Dr Hans-Jurgen Bachert from the Academy Central Institute for Optics and Spectroscopy studies the spectral position of laser light and displays the resonances on the screen.

3. p 5. These are a few models of the new light conductors made of superpure quartz glass developed at the Physical Institute of the Soviet Academy of Sciences. An optic cable of only 13 mm diameter can carry as many signals as a multiple-wire copper cable as thick as an arm.

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GDR, USSR TEST LOW-TEMPERATURE CABLES AS SUPERCONDUCTORS

East Berlin NEUES DEUTSCHLAND in German 3-4 Nov 79 p 13

[Article by Klaus Ziegert: "Low-Temperature Cables Offer Almost No Resistance to Current--Experimental Section of the KWO (Oberspress Cable Works) Uses Cryotechnology for Energy Transfer--Operating Principle Researches for the First Time in the Network of a Large Enterprise"]

[Text] Bizarre tire structures surround the cable, which is more than an arm thick, at those places where a piece of thermal insulation has been removed for measurement purposes. One is involuntarily reminded of a refrigerator and is thus on the right track. A cooling coil runs through the interior of the cable and with it, through the grounds of the plant. Liquid nitrogen flows through a corrugated steel pipe in the center of the cable and supplies the necessary cooling of the test range in one section of the Wilhelm Pieck combine of the Oberspree cable works. Here began a test unique in Europe: a cryoresistive cable was inserted in the power grid of a large enterprise.

Cold Helps Surgeons and Power Plants in Their Work

Modern technology has taken the syllable "cryo" from the Greek and used it to mean "pertaining to very low temperatures." The test cable is another interesting example of how most recent technological information helps create new uses for an otherwise undesirable state: cold. Cryotechnology is just being used in medicine for the well-being of mankind--deeply cooled surgical instruments prove their advantages in operations on the neck, nose and ears, and in tumor therapy. Cryoconstructions are being talked about in the energy sector--large generators go "ice cold" during power generation and this results in high efficiency. The Tokamak 7 nuclear fusion plant soon to begin production in the USSR will operate for the first time with superconductive magnets.

The effect of superconductance was discovered in 1911: certain metals achieve an extremely high electric conductance when they are cooled down toward absolute zero. Practical application of this phenomenon is much more complicated. Superconductors still need liquid helium, a not inexpensive coolant, which in addition requires some technical equipment

which, for use on longer cable ranges, makes the entire affair seem questionable today.

But there is no question that for transmission and distribution of electric energy more effective solutions will be used which will reduce both losses of the expensive "life blood" of the economy as well as result in more economic cable designs. Outdoor lines--the least expensive version--cannot be run everywhere. The solution--utilization of the electrical resistance diminishing with temperature--will be incorporated in stages. Cryoresistive cables are one stage along the way to the application of superconductors.

Work on the development on cryocable-transmission lanes is being conducted by researchers from the Oberspree cable works together with institutes and universities of the GDR and with specialists of the Moscow Union Research Institute of the cable industry. With our Soviet friends, experiments are proceeding hand in hand, research results are being exchanged, test lanes are being jointly erected and operated.

At the Oberspree cable works test lane the aluminum conductor is cooled by liquid nitrogen--it is nonpoisonous, not combustible and of premium quality for electrical experiments--to a temperature of about 73° Kelvin (-200°C). Its electrical resistance drops to about one-tenth of the value found at normal temperatures. Therefore, a power output of up to 600 MVA can be sent along a cryoresistive conductor cable designed for 110 kilovolts, this is about 10 times the amount carried by a conventional oil cable of the same size.

Aluminum Conducts Current Better Than Expensive Copper

In principle, the cable is constructed of four elements: the conductor, the electric insulation, the cooling circuit and the thermal insulation. The latter, a thick mantle of mineral wool or high polymer foam beneath the outer tube, lets no cold out and no heat in. This is important because cooling requires energy. We are trying to find a cable which can handle transmission powers of such magnitude that more energy and costs can be saved than are needed for cooling, materials, etc.

In the selection of materials it was important that low temperatures demand exceptional material properties. Commercially available steels become brittle for this type of supercooling. But even this was not enough: in several cases a reversal of material properties occurs. But this does not always have a negative effect. For instance, at low temperatures aluminum is a better electrical conducter than copper; this is a great advantage in material economy. At the Oberspree cable works very rational solutions have been found and it has been demonstrated that cryocables can be manufactured with conventional twisting and insulating machines.

Assembly Has Been Mastered--Testing Continues

The end connections of the cable required numerous experiments to find the most suitable material to meet the different types of stresses—for instance,

the high mechanical stresses and low temperatures or the thermal and electrical field stresses. In addition, these assemblies need gaskets, connections, safety and measurement equipment made of different types of material.

The tests have been proceeding for only a couple of weeks. The specialists at the Oberspree cable works have been able to confirm with justified pride that the manufacture and assembly technology of cryoresistive cables has been mastered. Now, additional studies and tests are proceeding on testing of system parts on a real energy lane jointly with our Soviet partners. The relatively simple and economic design, the high material utilization and extraordinary performance during temporary interference in the energy grid are advantages of the cryocable. The task now remains to design an even simpler, more reliable and less expensive practical solution.

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ACTIVITIES OF MOLECULAR BIOLOGY INSTITUTE REPORTED

1979 Achievements

East Berlin NATIONAL-ZEITUNG in German 10 Jan 80 p 6

[Article by Dr Rolf Kraushaar: "Patents a Contributing Factor in Setting Pace; How Molecular Biologists Make Themselves Useful to the Economy Through Basic Research"]

[Text] In 1979, in addition to the numerous results obtained by their planned and purposeful basic research, researchers at the Central Institute for Molecular Biology of the GDR Academy of Sciences in Berlin-Buch have submitted nearly 50 proposals for innovations, and filed approximately 50 patent applications based on the results of their work and contributing to scientific and technical progress. In doing so, the molecular biologists in Buch have satisfactorily fulfilled a necessary prerequisite to the adoption of the 1980 pace in their own field of activity, in agreement with the instructions of the 11th Plenum of the Central Committee of the SED.

Thus, a collective of predominantly young scientists, perfecting special research equipment for the separation of delicate natural substances (proteins, nucleic acids) and the measurements of the processes which take place then, have achieved a time savings of 75 percent and at the same time a reduction to 1/4 of the amount of reagents required.

To what extent are such achievements in the field of basic research of general significance?

Genetic Information

The Central Institute for Molecular Biology is engaged, among others, in the analysis of the molecular structures and processes which characterize life, down to the cell, the smallest elementary unit of life. In this respect, the material carriers of the genetic information contained in the cell nucleus, the deoxyribonucleic acids (DNA) are especially interesting. In addition, proteins, of which each cell contains approximately 10 million

molecules, play an important role as structural building elements in energy and substance conversions, and as carriers and receivers of information. Genetic material in the cell nucleus is in the form of a DNA-protein complex and, because it can be stained, it is also called chromatin.

Chromatin research, therefore, is becoming increasingly important. With the presentation of partial results concerning the elucidation of chromatin structure and function, the Buch scientists fulfilled one of their obligations under the 1979 competition. In this context, it has also been possible to develop a novel theoretical chromatin model.

Significant progress has also been achieved with respect to the definition of ribosomal proteins, their interrelations and their organization. Ribosomes are minute cell organelles, only about 20 nm in diameter (1 nanometer nm = $1 \cdot 10^{-9}$ m) in which protein biosynthesis takes place. These "molecular machines" are surprisingly efficient: they can link 10 amino acids (the protein building blocks) together every second. A protein molecule consisting of 100 amino acids can thus be completed on a ribosome in only 10 seconds. This process takes place in the same manner in the human body. This is why results in this field obtained at Buch through basic research on rat liver ribosomes are of essential importance.

Test Brief

In addition, the development and clinical testing of a test brief to demonstrate the presence of occult (concealed) blood in stools has been successfully completed. It is used for the early diagnosis of stomach and intestinal carcinomas.

Molecular biologists have also made significant contributions to the improvement of animal production. Thus, as part of preliminaries to the production of an estrus-synchronization hormone jointly with the Berlin-Chemie state enterprise, new analytical methods have been developed and applied to optimize the production process. (Estrus synchronization makes it possible to concentrate within a small period of time the insemination of a large number of animals and therefore also the period over which the young are born. This means a considerable increase in the productivity of veterinarians, and animal breeders and keepers in the socialist agriculture.

Computer Coupling

To permit an early selection of calves on the basis of their muscle growth, preliminary work for the practical application of a protein biosynthesis test have been successfully completed with the cooperation of the Academy of Agricultural Sciences of the GDR.

The intensification of scientific work itself is served, for instance, by the application of the micro computer system MRS 4944 to the control and

recording of measurements made by an X-ray small-angle diffractometer. With this complex and expensive instrument, it is possible to elucidate the molecular architecture of proteins and nucleic acids. Its coupling with the microcomputer represents a new qualitative step toward the automation of scientific experiments and, therefore, toward a better utilization of valuable basic research tools.

Certainly, discovery and invention, advances on new ground, are part of scientific work. Was the mobilizing force of competition then necessary to solve the tasks which had been planned? The results speak for themselves: even in the field of research, rivalry has been a stimulant and has brought greater effectiveness.

Interview With Director

Leipzig URANIA in German Vol 56 No 3, Mar 80 signed to press 25 Jan 80 pp 4-8

[Interview by Dr of Agriculture Eva Mai, department head, URANIA editorial staff, with Prof Dr of Medical Sciences Friedrich Jung, director, Central Institute for Molecular Biology, GDR Academy of Sciences; date and place not given: "Molecular Biology, a Promising Research Field for the Future"]

[Text] The constant observation of international trends in science and production has made it possible to derive long-term objectives, not the least for basic research in our country. Generally, we are trying to achieve a leading position in vital areas. The personnel of the Academy of Sciences of the GDR--in particular those representing molecular biology--have accepted the political, economic and scientific requirements which have been emphatically outlined by the 11th Session of the Central Committee of the SED.

Friedrich Jung was born in 1915 in Friedrichshafen on the Lake of Constance. He completed his medical studies in Berlin in 1940, when he presented a doctoral thesis on toxicological problems in the hemoglobin. Because of his rejection of Hitler-fascism, his habilitation was deferred. Until 1949, he was lecturer at the Tuebingen University and professor of pharmacology. In 1949, Prof Friedrich Jung became professor of pharmacology at the Humboldt University in Berlin. At the same time, his association with the Academy of Sciences at the Buch research center began. There, he later became director of the Pharmocology Institute. He is a regular member of the GDR Academy of Sciences and, since 1972, director of the Academy's Central Institute for Molecular Biology. He is a pioneer

in the field of electron microscopy, especially with regard to the treatment of red blood cells. His scientific activity bears primarily on hematoxins, the functions of hemoglobin, and the effectiveness of peptide drugs. The results of this work are recorded in nearly 400 original scientific publications. His many years of work in the GDR peace council and his active participation in the GDR cultural association clearly show that, to him, his responsibility as a scientist is closely tied with political life in our country. His work for the GDR has been rewarded twice, with the national prize and with the silver national order of merit. Professor Jung is meritorious physician of the people, and meritorious professor of the people.

[Question] The concept of molecular biology has become very common. Could you please describe briefly what it covers and whether is has to do "only" with basic research or also with scientific fields which have already found practical applications?

[Answer] Molecular biology analyzes the molecular components and mechanisms of vital processes. There, we are facing complex questions. These processes begin in individual biochemical systems inside the cell; they concern the behavior of the cells, singly or in association; the control, through molecular processes, of the interplay of organs in plants and animals; and also problems of the interaction between animate and inanimate environments. None of these processes are isolated from one another, they exert a reciprocal influence on one another. They are imbedded in changing geophysical conditions.

Besides, I would not separate basic research from the scientific fields which find practical applications; rather, we expect basic research, in each case, in the short or in the long term, to yield or prepare results which will find practical use, namely in the development of our national economy, or in protecting public health. Therefore, the vital motivation of all our work is its effectiveness for our society and for humanity in general. It extends to economic and technical questions related to actual practical utilization. We also try to organize our work so that transfer problems are solved at the same time.

[Question] Could you give an example to explain these connections with public health protection?

[Answer] Take my former specialty--drug research. If I wanted to develop a new drug, until now I could chose two ways: I could go into nature and look for suitable substances, or I could turn to a chemist and he would, at will, prepare any number of compounds or isolate any number of natural substances. Then, I would set up a comprehensive screening program

including tests and studies to find out whether and how the new product is working and for what it can be used. This is, as it were, the traditional way. This is how man has dealt with medicinal herbs in former times, this is how we used to start from new chemical compounds. But, today, we know more about the manner in which the active components in an active substance work together with the molecular systems of a cell. In many cases, we even know very well how a given substance contained in a plant will react with the genetic material, with the so-called receptor molecules in the cell membrane, or how it will influence metabolic processes which provide energy to the cell. Once we know these laws, we can begin to construct as the following example will show.

For a very long time, man has been looking for strong pain-killers. Today, research on the active substances which have been found to exist in the human central nervous system has given us a relatively accurate knowledge of their chemical composition. The enkephalines, for instance, are typical --these are short-chain protein-like compounds, called peptides. They work like morphine. Of course, these endogenous active substances cannot be used as drugs. They have a very short life span. This is why, if we were to take them in tablet form or as injections, they would generally not reach the central nervous system. However: we know what the specific, i.e. the active centers of these peptides are, and we know their structure. This is where we start to reach our aim. These peptide centers constitute the starting point in designing new, highly effective compounds--made to measure! We were particularly interested in new drugs against cardiac insufficiency, and we shall now be interested for a long time in preparations against cancer and viral infections.

[Question] Molecular biology also deals with another subject related to these problems--enzyme research. What course of action will you follow there?

[Answer] We, in molecular biology, are very much interested in enzymes. We isolate them and study how they work and how they could find applications in economic processes, for instance in the production of foodstuffs or in medicine, as therapeutic or diagnostic agents. Research in molecular biology also contributes to modify enzymes so that they are more easily handled when used in "technical" runs. For instance: An important problem in medical diagnosis is how to use simple and sensitive methods to detect the presence of increased sugar levels in blood or urine. For that, we do have the traditional complex chemical methods. But today, this detection can be achieved much more simply and easily with enzymes and, above all, it can be made in the test tube. However, for the physician or his technical assistants to handle a test tube is mostly complicated and it is time-consuming. Therefore, we are trying to use test strips on which a drop of blood or urine is placed. Depending on the color it takes, we know what amount of sugar is contained in the body fluid used. For that, we can now use certain enzymes, for instance glucose-oxidase. In the

presence of glucose, it triggers a series of reactions which lead to the development of a color on a test foil. These foils will be available to medical practitioners in 1980 or 1981. A series of complex problems are involved: How can I modify the enzymes so as to make them heat-stable, to give them spatial stability (i.e. to attach them to a fixed carrier), to prevent them from being decomposed by bacteria? If an enzyme were that easy to handle, I could, of course, use it not only for medical diagnosis, but also for material transformation processes in the chemical industry, to name one example. Today, we have reached the point where we can chose to use enzymatic processes for certain reactions used to produce complex and expensive drugs, like the conversion of steroids--they include, among others, the sex hormones and the adreno-cortical hormones. They are more selective and may even fulfil their purpose better than any other chemical catalysts or reagents. In addition, they save us whole steps in drug production.

(Question) One complex in your scientific field holds much promise for the future: The continued study of genetic material--will it revolutionize biology?

(Answer) Today, molecular biology and especially molecular genetics have already achieved extraordinary progress in the treatment of nucleic acids --the genetic material. We know their chemical structure, we can analyze them. But much more decisive is the fact that we have begun to modify them, so that we can actually handle nucleic acids more and more frequently the way the chemist handles his reagents. And this permits us to recombine genetic material or even to synthetize it, i.e. we can create genetic material having new properties, and we can implant it into the cell. This way, we can produce bacteria, for instance, or maybe in the future even cells of higher organisms with new genetic properties!

I would like to give you an example of this too. Until now, insulin--the drug for diabetics--has been laboriously isolated from the islet cells of the pancreas of calves or pigs. Its structure, however, does not correspond to the structure of human insulin, which the diabetic actually needs. If we succeed--and we have succeeded--in producing the insulin gene synthetically, or in isolating it from human islet cells and then, for instance, introducing it in the genetic material of bacteria, these bacteria can then produce human insulin. And this gives us the possibility of producing this type of hormones, but also perhaps vaccines or other important drugs, the way we produce penicillin--through a fermentation process. With new production methods like these, we can obtain substances specific to man which neither animal nor plant sources can provide. Just think of producing the hormones of our pituitary gland, the hypophysis, or, as I mentioned before, think of the new hormones and active substances which have recently been found to exist in the central nervous system.

I would like to go one step further. With such "genetic operations," it will be possible to obtain entirely new performances from bacteria. These operations can then also be extended to higher organisms, for instance to useful plants or domestic animals. It will become possible to modify their genetic material in such a way that the result of biological production--which is important in agriculture--will be increased; one of the most important long-term objectives of molecular biology and, in a narrower sense, of molecular genetics.

[Question] As we have seen, the results obtained by molecular biology affect to a large extent the interests of national economy and human health, and will continue to do so in the future. Without doubt, this is where the new building for molecular biology research in the GDR, built here in Berlin-Buch and inaugurated last spring, fits in. What purpose will it serve in our country and with respect to research cooperation within the CEMA [Council for Economic Mutual Assistance]?

[Answer] The research tasks which have to be solved under the recently introduced working conditions follow, in the long term, the directions which I have just indicated. Cooperation with researchers in socialist sister nations will play an important role. For instance, in October 1979, we have negotiated the details of a special multilateral Academy agreement. There are also CEMA agreements--for instance in the field of biophysics--under which we meet to discuss and harmonize the objectives of our work and its practical utilizations in the national economy. In the field of molecular biophysics, proteins and nucleic acids, the determination of their structure, etc., there exists an intensive and successful cooperation with the Soviet Union and the other socialist countries. We are also cooperating successfully in certain areas of molecular genetics.

[Question] In the future, will molecular biology also contribute to solving international problems--for instance those of food or energy? In the field of energy production and utilization more particularly, are there molecular processes which could be used as models by man?

[Answer] In the short term, it is certain that molecular biology will, first of all, contribute to food production. In this respect, there is a problem which has concerned me a lot for many years, mainly because it involves a large joint research project with the Soviet Union. It is the production of monocellular protein to feed our livestock (see URANIA 6, 1976; editor's note). In the GDR, we have obtained a certain success. However, problems remain concerning the organisms to be used, the analytical processes, etc. The point is to find the most highly effective process. These, among others, are the projects on which our institute is working. Another one is the development of enzymatic processes to ripen meat, research on aroma with respect to foodstuff substitutes, food toxicology, etc. All these are problem areas to which molecular biology gives a start, directly or indirectly.

With respect to the energy problem, the question, to me, is a little more complex. For the moment, I do not see yet any concrete prospect through which molecular biology could contribute in solving our energy problem in the near future. But if one looks, for instance, at the molecular biology of photosynthesis in green plants, well, for the time being this is actually the most efficient and the best process in the world when it comes to conserving solar energy. In final analysis, it is to this process that we owe all of our coal, all of our oil. Photosynthesis is the fundamental process. It is far more effective than, for instance, what engineers can achieve with their silicium photoelectric cells and such. And photosynthesis in green plants is one of the basic problems which molecular biology--especially in the Soviet Union but also in other countries--is intensively investigating. All this occurs in the hope that a deeper understanding of this process will either lead to the development of new technical principles for the transformation of sunlight, or that, through genetic manipulations, we can bring plants to carry out the photosynthetic process with increased effectiveness. It is just not so that all plants are equal in this respect, or that special conditions for this process do not exist in the various climatic zones. In my opinion, molecular biology will certainly be able to yield definite information on this in the future--say, around the year 2000. Second: We are not only trying to conserve solar energy, we also want to use as effectively as possible the energy which we already have--i.e. from sun, wind, water, coal, etc.--we do not want to waste it somehow or other in our technical processes, but rather to convert it with a high degree of effectiveness, for instance into chemical, mechanical or electrical energy.

Here also, there are biological examples of fascinating effectiveness. Take the muscle. It works much more effectively than our best combustion engines. The muscle--in final analysis it burns glucose; a combustion engine requires gasoline. Which is more effective? We hope that an intensive study of these processes, of the chemical compounds and biomacromolecules in the muscle will enable us to learn how we could one day build better engines, convert the energy more efficiently. Certainly, these problems will also be studied in our new building at some future date.

[Question] To conclude, another question which our younger readers keep asking. They want to know if there is such a profession as "molecular biologist" and, if there is, which branches of study should they chose to prepare themselves for it as fully as possible?

[Answer] There is of course no such profession as "molecular biologist." Molecular biology is a field which cuts across biology, medicine and natural sciences such as physics, chemistry and mathematic and in which these disciplines are closely interwoven. I would recommend that the young person interested in a modern and momentous scientific field like molecular biology study one of these subjects--always starting with biology or medicine. During his studies, he will find out what interests

him most, where his knowledge and abilities can be most useful to himself and to society. It could be in drug research or in basic research. However, he could also find his field of activity in the applied disciplines, for instance microbiology, or the chemical industry, or other branches of the industry.

We thank you sincerely for this interview.

Enzyme Research

East Berlin SPECTRUM in German Vol 11 No 2, Feb 80 pp 15-17

[Recorded interview with Prof Dr Peter Mohr, Central Institute for Molecular Biology, GDR Academy of Sciences by Elisabeth Manke, engineer, SPECTRUM editorial staff: "Prospects for Enzymes," date and place not given]

[Text] Scientific reports at home and abroad show that research and industry are increasingly interested in enzymes, especially fixed enzymes, and their possible applications and utilizations. The GDR Academy of Sciences, too, is giving its attention to these question, jointly with other scientific institutions, and the pharmaceutical and chemical industry. The relevance of enzyme research becomes obvious when one takes a closer look at the properties and fields of application of these protein compounds. This is why SPECTRUM has interviewed Prof Dr Peter Mohr from the Central Institute for Molecular Biology concerning some aspects of enzymology.

[Question] Why are science and industry interested in these biocatalysts, the enzymes? Would it not be simpler to use technical catalysts?

[Answer] In principle, enzymes--which are protein compounds--have properties similar to those of technical catalysts? However, compared to the latter, they present decisive advantages, and a few drawbacks as well. For instance, enzymes generally reach their optimum effectiveness between 0°C and 40°C, while technical catalysts can be used only at much higher temperatures and, in addition, in the gas phase. Besides, enzymes are effective under normal pressure, and in only one solvent system, water. For this reason enzymes cannot replace technical catalysts; they are a valuable complement which opens the way to entirely new types of potential applications.

At present, we know approximately 2,000 enzymes, and we can produce approximately 150. A few have already found an application. In the future, we shall not use them only in research, to activate biological, biochemical and biophysical processes; because of their full effectiveness and their substrate specificity, they will also find use in the national economy.

For instance, in the food production and beverage industries, in agriculture, in human and veterinary analytic and therapeutic medicine, in drug biochemistry and in the microbiological industry, in the pharmaceutical and chemical transformation industry, and not the least also in environmental protection.

[Question] What are the possibilities of taking better advantage of the effectiveness of enzymes?

[Answer] This is an important question. Scientists are trying to counter enzyme instability by fixing enzymes, or enzyme-containing cell fragments or cells. (What we call fixed enzymes are those which are bound to a polymer compound (a matrix) or included in it.) The enzyme, for instance, is bound to a polymer compound or included in it, in such a manner that enzyme activity is retained to the largest possible extent. Such fixed enzymes offer several advantages compared to free enzymes. The enzyme preparations can be used separately and repeatedly; this reduces the costs. The reaction volume necessary is much smaller, the processes can be run continuously. In addition, fixation increases enzyme stability.

Microorganisms are the first to come into consideration as enzyme builders. Through optimization of their growth conditions, and through genetic manipulation, it is possible to increase the enzyme yield. The selection of such enzyme-building microorganisms is one of the essential conditions to the broad application of enzymatic active principles. There lies one of the problems of our research: the extraction of enzymes, on the one hand, from available raw materials, such as microorganisms--on the other hand also from plant and animal wastes, as well as from tissue cultures of animal and vegetable origin. We are even considering the future utilization of genetic techniques for the microbial synthesis of human-specific enzymes.

[Question] You have indicated before that there are numerous application fields for enzymes. Could you explain this in more detail?

[Answer] The range of enzymatic active principles which have found practical use has been considerably enlarged during the past years. Well-known industrial processes can be designed more rationally through the use of enzymes. An example is the production of sugars for the food industry. Through the chemical or enzymatic decomposition of corn or potato starch, glucose (which some call grape or corn sugar) is first obtained. The subsequent partial conversion of glucose into fructose, with the help of the enzyme glucose isomerase, brings about a considerable increase of the sweetening power. The process developed for this purpose has already proved industrially successful. Another example is the brewing process, which has been known for centuries. Four basic substances--water, barley, malt and hops--are necessary to produce beer. However, up to 50 percent of the malt required can be replaced by microbial enzymes without affecting

the taste of the beer. Enzyme blends for this purpose are produced in the GDR, the USSR, the United States and Denmark, to name only a few.

Another objective of our application-oriented enzyme research concerns the decomposition of the cellulose contained in vegetable raw and waste materials, in old papers and others. With the help of enzymes, the cellulases, it should be possible to break down polymolecular cellulose into smaller s u g a r s, for instance into glucose. Such products could then be used directly as animal feed, or as starting material for the production of ethyl alcohol (through alcoholic fermentation), or for the microbial production of protein. Although development of the industrial application of these enzymatic active principles will require much more time, it is to be expected that it will open entirely new prospects in various branches of the industry.

The numerous, and economically beneficial, application possibilities which we anticipate for the enzymes which break down cellulose have led to an intensification of basic and biotechnologically oriented research in this field.

Enzymes are already important in medical diagnosis and biochemical analysis. They have made it possible to rationalize many of the old processes, or to replace them through new effective methods. An example is the determination of glucose in blood and urine for the diagnosis and control of Diabetes mellitus. The relatively unspecific methods--some of which still in use today--using metal complexes are increasingly supplanted by enzymatic methods which make use of the ability of the enzyme glucose oxidase to catalyze the conversion of glucose, with atmospheric oxygen, into gluconolactone and water.

At present, collectives of our Academy are closely cooperating in health and academic institutions to develop a glucose electrode and the necessary measuring apparatus, as well as other enzyme electrodes. When the basic enzymatic reaction at the glucose electrode is coupled with another enzymatic reaction during which glucose is either formed or consumed, its range of uses is considerably enlarged. For instance, the enzyme invertase which is formed in microorganisms also causes the breakdown of beet sugar (saccharose) into fructose (fruit sugar) and glucose. The latter can again be measured with a glucose electrode, and the value obtained is identical with the saccharose concentration. Based on this measuring principle, it is possible to determine the concentrations of maltose, starches, cellulose, pyridine nucleotides, adenosine triphosphate, and of the enzymes α-amylase, glucoamylase and cellulase.

For the time being, only two determination methods (for glucose and for urea) are used, but we expect to see an increase in the practical application of these analytical measurement principles.

[Question] How are enzymes used to prepare natural substances which are not readily available?

[Answer] There are various possibilities. Affinity chromatography is a method which has proved increasingly successful. Its principle rests on the ability of an enzyme to react only on selected components which fit its spatial configuration. In affinity chromatography, the procedure consists in placing the fixed water-insoluble enzyme in a chromatographic column. Then, the solution which contains the substance to purify is added; only the latter binds with the enzyme and can later on be separated again. Thus, it has been possible in the past few years to produce biochemically important compounds and structures in high purity form, or even just to identify them--that has been the case for various proteinase inhibitors, antibodies and nucleic acids. Much preliminary work leading to scientific progress has been achieved in various fields of molecular biology and medicine. A few methods for affinity chromatography, using fixed enzymes, are already used for the commercial production of fine biochemicals and biosubstances of medical significance.

Affinity chromatography has provided a new separation principle based on biospecific complex formation. It has made the isolation and purification of many substances either considerably more effective, or possible for the first time. The losses of activity are less than with other methods because the substances to be isolated are stabilized, since biomacromolecules are generally more stable in complexes than when free.

[Question] From all you have said, the practical importance that enzymes will have in the future is evident. What future possibilities do you anticipate for enzyme utilization?

[Answer] Processes and methods based on enzymatic active principles are being increasingly used in the field of public health.

In the future, enzymes will also bring us entirely new technologies or a rationalization of our present methods and techniques. At the Academy of Sciences, several collectives are carrying out basic research with the objective of creating the conditions necessary for greater utilization of enzymes in the GDR. This work takes place in close cooperation with technical and academic teaching institutions and with the industry. They are part of cooperation agreements with the USSR and the other socialist countries.

The pharmaceutical industry is already offering testing paper-strips for the diagnosis of Diabetes mellitus or to check diabetic patients. They dispose of all the reagents required for the detection of glucose. When a drop of blood is placed on these test strips, color appears after a short period of reaction and after the remaining blood has been rinsed off. By comparison with a color scale, a semi-quantitative evaluation is possible; or a quantitative evaluation if one uses a reflection phonometer.

Strip tests using enzymes have also been developed for the diagnosis of other diseases, for instance organic function disorders. One of their greatest advantages is that they can be used anywhere and at anytime without costing much, and that their application does not require any special knowledge.

To conclude, I would like to refer to a problematic which has found special treatment at our Academy. Among the many industrial processes which are used today, the microbial synthesis of proteins from primary or secondary raw materials is of particular importance since it will contribute to cover the increasing protein deficit in livestock raising and feeding. Basic reasearch on this is striving first to gain knowledge on the enzymes involved and their mechanisms of action, and it can provide an important contribution to the optimization of these processes. With similar objectives in view, a working group of the Central Institute for Molecular Biology is studying the first steps of microbial alkane utilization, which is catalyzed by an enzyme system of the type cytochrome P-450.

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CSO: 2302

ECONOMIC APPLICATIONS OF ISOTOPE RESEARCH CITED

Leipzig URANIA in German Vol 56 No 2, Feb 80 signed to press 18 Dec 79 p 67

['Mosaik' feature article: "Isotope and Radiation Research at the Service of the Economy"]

[Text] Research results obtained at the Central Institute for Isotopes and Radiology in Leipzig are used in industry, in agriculture, medicine and many other fields. Workers at this institution of the Academy of Sciences of the GDR have, among others, created the bases for the development of radiation chemistry processes for the production of boilproof polyvinyl chloride (PVC) and impact-resistant polyethylene. Scientists have provided the Bitterfeld chemical collective combine with a new technological operating principle for the chlorination of PVC. It saves 4 stages in the process and, as a result, a gain of 540 marks per ton of PVC is achieved. According to the director of the Institute, Prof Dr Klaus Wetzel, the Leipzig scientists are also working on the gamma irradiation of liquid swine manure, to be able to use it as animal feed reserves. The irradiation of cereal straw can also be used to increase the nutritive value of such raw feed materials. Preliminary partial success has already been achieved. "The irradiation of sewage, especially from municipal, industrial and agricultural origin, is becoming increasingly important," remarked Prof Wetzel. Thus, preliminary investigations at the "Panorama" high-dosis gamma irradiation plant installed at the Institute have yielded good results with respect to the decontamination and separation of toxic compounds. The high cost and energy requirements do not yet allow a broad application of the irradiation process. However, work is in progress to make this process economical. Building on results of research at the Central Institute, the GDR has, in the past few years, taken a leading position in the world in the field of production, analysis and application of the stable nitrogen-15 isotope. The Bitterfeld chemical collective combine is presently producing one third of the world's production of this isotope which makes it possible to detect the absorption of mineral substances by plants. For this purpose, fertilizers are marked with the isotope.

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CSO: 2302

MORE MICROELECTRONICS STUDY PLANNED FOR TECHNICAL STUDENTS

East Berlin PRESSE-INFORMATIONEN in German No 22, 21 Feb 80 p 2

[Article by Bodo Weidemann, state secretary for vocational education: "Microelectronics Places New Requirements on Vocational Education"]

[Text] The accelerated development and application of microelectronics is a decisive prerequisite for thorough improvement in the technical and technological level of our production. Consequences are also derived from this for vocational education. The demands of scientific-technical development were taken into consideration by the introduction of the basic technical subjects of electronics, BMSR technology and data processing in 1968--building on the previous efforts of the polytechnic universities with the expansion of basic technical subjects and revision of instructional plans for all educational occupations after the Ninth Congress of the SED.

Microelectronics poses new demands. Our previous investigations confirm that the educational content of individual subjects in a series of vocations require further refinement. It also turns out that in factories and combines, changes in the planned or existing vocational structure become necessary, for instance, the development of electricity monitors into electronic technicians, and of machinists into technicians for automated systems.

The decisions on the development of the vocational structure must therefore be taken jointly with the departments of research and development, technology and the production departments in the combines and factories. Our studies also indicate that the new work content resulting from the use of microelectronics and the educational requirements of the technician derived from this do not result in new occupations.

Conclusions for Education and Training

After the necessary scientific prerequisites had been created in the preceding 2 years, the state secretary for vocational education is now studying, jointly with certain technical ministries, what can be done to secure the required educational sequence.

Therefore, at present, in the individual areas of the economy, analysis is being performed to determine which new problems result for the manufacture, processing and use of microelectronic assemblies, elements and equipment and what effects this will have on the content of certain technician occupations. For example, this concerns occupations like electronic technician, BMSR technician, mechanics for data processing and office machines as well as clockmakers. The task consists in adapting instructional material and numbers of hours in the individual subjects to future needs.

Increasingly, consequences are being drawn from scientific-technical progress for training of technicians. Erich Honecker stressed to the first secretary of the district directorate of the SED that today, a high level of practical training of the young generation, including creative thinking and acting, consciousness and activities are of decisive importance for our progress. In addition to theoretical viewpoints, capabilities for effective action in complex technological processes, certain modes of behavior and common traits--like consciousness of responsibility, reliability, maintenance of technological discipline--must be stressed increasingly. Therefore, the named studies deal with conclusions for education and training.

Continuing Education of the Instructors

Vocational education in the GDR can only perform its progressive function in the implementation of scientific-technical progress if the instructors in practical and theoretical courses have applicable knowledge about the most recent technology. Continuing education for the technician is predicted upon an even greater education of the instructors.

Under this viewpoint, since the sixth meeting of the Central Committee of the SED in June 1977, many potentials for further training in the area of microelectronics have been created, primarily under the leadership of the Ministry for Electrotechnology and Electronics. Several of these are: the institute for training engineering instructors in Gotha has conducted advanced education courses in microelectronics for directing cadre and instructors in vocational education. The center for vocational education of the Ministry for Electronics and Electrotechnology in Dresden is organizing courses for instructors in theoretical education. The TV and radio combine is initiating courses in the application of microelectronics to radio and TV technology. The district office for continuing education of the cadre supports these further education measures through their sections.

The joint conclusion of the Ministerial Council of the GDR and the Federal Committee of the FDGB on 21 June 1979 on further increasing the level of adult training requires that in the cadre and educational plans of the factories, the necessary educational measures must be established as they result from the manufacture, processing and application of microelectronic assemblies, components and equipment. These continuing education measures are to be prepared under consideration of future demands and of long-term work experiences. Continuing vocational education of active technicians is often the most effective possibility of qualification in the introductory and preparatory phases of a scientific-technical renovation as is being initiated by microelectronics.

9280
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ROBOTRON CENTER FOR EDP, COMPUTER TRAINING DESCRIBED

East Berlin BERLINER ZEITUNG in German 29 Feb 80 p 3

[Article by Dr Karl-Heinz Gerstner: "Training of Specialists for the Computer--High Output Robotron Training Center in Leipzig"]

[Text] In addition to microelectronics and the use of industrial robots, the application of electronic computer technology plays an important role in more efficient organization. This was stressed at the 11th plenum. Several articles will describe how the Robotron combine--the GDR's sole manufactureer of EDV systems--is acting to intensify application of modern computer technology.

In the flat blue building on Gerber St in Leipzig opposite the Astoria Hotel and next to the Merkur Hotel (nearing completion) we find the Robotron Systems Division. The factory is responsible for assembly and final delivery of electronic computers to users, for servicing the systems both domestically and abroad, for repairs, storage of spare parts (this encompasses about 108,000 spare parts)--in short, for the whole gamut of customer service with respect to Robotron electronic data processing systems.

One significant part of this customer service is training and education of technicians to assure effective use and proper maintenance of this equipment. Therefore, in the Robotron building in Leipzig a large educational center has been set up. In the last 20 years, 170,000 EDP specialists from all over the world have been trained. Therefore, it is an intellectual center for the entire process of application of electronic computer technology which is so important for efficient organization of the entire state economy.

Some 190 university lecturers provide instruction in 130 different types of courses, relating to the following technical areas among others: EDP systems, small and processed computer systems, data-collection systems, small programmable plotters, microcomputers, data-processing technology, data-acquisition equipment, office technology.

For these training purposes the instructional center has nine central units of data processing which were manufactured in the GDR within the framework of the ESER project. These are primarily Robotron EC1040 (380,000 operations

per second) and the EC1055 (480,000 operations per second) data-processing systems--which were completed as the new computer generation on the 30th anniversary of the GDR. In addition, training is performed on numerous types of process computers, microcomputers and peripheral equipment. The most modern systems are used for training. Many of the trained specialists will be used as service technicians to maintain the 1,200 computer centers in the GDR and the 250 EDP systems manufactured in the GDR and used abroad. Even programmers and data-processing technicians as well as engineers for data-processing obtain intensified practical occupational knowledge here. The students are technicians who usually have university degrees and several years' experience.

If we recall that a modern data-processing system consists of hundreds of thousands of components and circuits and that during a malfunction, the single damaged circuit must be found, then it is understandable that these specialists must have not only a high level of technical training but also years of experience. In certain courses so-called false search strategies are taught. Film presentations with simultaneous lectures for the numerous foreign participants and other modern teaching aids are used for effective instruction. Instruction takes place in small groups of up to 15 persons using their particular equipment.

The foreign students come primarily from countries using the GDR electronic computer equipment. At present there are 18 countries, primarily the Soviet Union, where 120 central units using the EC1040 are in operation. Other countries include the CSSR, Poland, Hungary, Yugoslavia, India, Iraq, China, Cuba and Angola. In the first half of 1980, 120 courses having more than 1,000 students were taught at Leipzig. Of these students, 60 percent were foreign and 40 percent came from the GDR. The Robotron instructional center has a modern dormitory with 450 beds nearby. The foreign participants are housed primarily here.

The COMECON countries have created a uniform system of electronic computer technology, called ESER, a large program of production and application of modern computer technology in which each of the European COMECON countries has its specific production task. Within this framework, the GDR manufactures the medium-capacity, high-performance Robotron EC1055 computer. The other COMECON countries have met their quotas in the ESER system so that today there is a modern electronic computer system available for employment in all areas of the national economy.

In 1969, the COMECON nations created the NOTO service organization for the constantly increasing numbers of computers. The Robotron products division in Leipzig is a member of NOTO and performs complex customer service within the framework of the central COMECON service organization for the computers built in the GDR. It has assumed customer service for all ESER systems in the GDR since 1 January 1980.

9280
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RESEARCH TRENDS IN DEVELOPMENT OF INFORMATION SYSTEMS

Bucharest REVISTA ECONOMICA in Romanian No 1, 4 Jan 80, No 2, 11 Jan 80

[Article by M. Draganescu, M. Guran and A. Davidoviciu: "New Directions of Research and Activity in Data Processing"]

[No 1, 4 Jan 80 pp 17-18, 29]

[Text] The 12th Party Congress, that great event in the lives of our people, ratified the documents that outline the objectives for a new stage of Romania's development based on introduction of the latest scientific and technological advances. In the data processing field too these documents are a valuable guide for future activity and for research, planning and operations in electronic computing centers or in information systems.

Development of the machine building industry will provide the material conditions for new activities in data processing that are expected to contribute to the growth of general labor productivity and to efficient management of the industrial processes, economic units and sectors of the national economy.

In specifying the tasks assigned in the Directives of the 12th Party Congress to mechanize, automate and cybernetize production, Nicolae Ceausescu also said, "Industrial productivity is to show an average annual growth rate of 7-7.5 percent in the next five-year plan, contributing about 80 percent of the production increase. To this end an important part will be played by expanded mechanization and automation, manufacture of completely automated production lines, especially in foundries, forge shops, heat-treatment and other labor-intensive sections, and use of multipurpose unit-head machine tools, industrial robots and small-scale processors. Steps are to be taken for cybernetization of industrial processes, generalization of work with several machines, rational use of working time, use of electronic equipment in scheduling production, calculating and recording, and consequent reduction of office personnel to the minimum." (1)

Concerning the new directions of research on data processing, which requires both basic and applied research, we quote the following guidelines from

the speech of Elena Ceausescu, chairman of the National Council for Science and Technology, at the 12th Party Congress: "In all research work, alongside the effort to develop the applied sciences to solve current problems, basic studies must be regurlarly emphasized to lend the entire activity a broad perspective... Meanwhile Romanian research is to play an active part in discovery of the universe and the seas and oceans and in study of the laws of nature, the movement and conversion of matter, and the interdependence between nature, life and society." (2)

On the basis of the ideas in Nicolae Ceausescu's Report to the 12th Party Congress, the Directives of the congress that set the sights for a decade of science, technology, effectiveness and quality, the discussions at the Congress, and the scientific discussions before the congress among the data processing specialists, we shall try to present some of the new trends of research and activity in data processing that we consider important to the new stage we are entering. We shall note that in the case of Romania the new is required both by a certain stage of development we have reached that calls for introduction of types of activities in Romania that are in full course in the developed states of the world, and by the present stage of information science and technologies making it necessary to fall in step to a greater extent with the worldwide development of this field.

While realizing that data processing can make a great contribution to productivity in all fields, to better management and to radical changes in the nation's socioeconomic activity (3), we must also realize that the present development of information structures in Romania lags behind industrial development. In our times, a nation's developmental level also depends upon the information structures that it has, nor can a nation be said to be industrially developed and underdeveloped from the information standpoint at the same time. The ties between data processing and automation and between automation and the production processes are becoming so close that underdeveloped information structures would impede industrial progress as well as technical progress in social organization and management. Consequently the nation's information structures are vital to its socioeconomic development (4).

Present Stage of Data Processing in Romania

Construction of information systems according to the tasks and objectives in the party and state documents has now been undertaken for the following categories of systems:

1. Systems for managing enterprises and centrals;
2. Systems for controlling industrial processes;
3. General operational systems and those for managing tasks or activities on the level of the economy;
4. Systems for regional management.

In constructing information systems on the microeconomic level especially some methods of design and standards for approval have been developed, as well as program-products for general use based on a typologizing [tipologizare] effort, and information instruments permitting use of a computer in

designing, with favorable effects upon labor productivity and the quality of the designs. By the end of 1980 over 1,000 representative economic units in all sectors of the economy will benefit by information systems (general or for managing some activities) and dozens of systems for controlling industrial processes. There will be 14 systems for managing some sectors and activities on the level of the economy and three general operational systems will be partially constructed, as well as regional management systems in five counties.

At the close of the third quarter of 1979 over 400 electronic computers (over 170 with medium capacities and over 200 with low capacities) were in use in the economy, and about 40 minicomputers. There are also more than 7,000 primary data processing units and over 10,000 invoicing-accounting machines. This year we have started to provide the economy with various kinds of terminals (over 900 terminals), and the first domestically manufactured minicomputers will be delivered.

Over 1,200 data processing units are in operation in the national economy (100 centers, 734 computing offices and 425 computing stations), staffed with nearly 40,000 workers, 10,000 of whom have higher education. In the third quarter of 1979 these units processed over 20,000 data processing applications, about 15,000 of which were placed in use. Most of the applications (95 percent) concern problems of the enterprises' and centrals' activity, with the following distribution: technical-economic planning, 11 percent; scheduling, starting and checking production, 28 percent; supply, sales and stockpile administration, 28 percent; finance and accounting, 16 percent; and personnel-remuneration, 13 percent.

Various units are doing research on data processing. The Central Institute for Management and Data Processing has over 40 research projects largely concerning problems of constructing information systems on the microeconomic and macroeconomic levels, developing program-products on the basis of standard designs or general use, and developing systems for managing the data centers, programming languages, and new methods and techniques for constructing the systems graduated in real time, the computer networks, the systems for controlling industrial processes with minicomputers and microcomputers, etc. More intensive efforts have been made recently to organize scientific and professional meetings of real use for broad exchange of experience and promotion of the best results, like the recent symposiums at Timisoara and Sibiu on some subjects of wide interest*.

Construction of Information Systems

Construction of information systems is characterized by the following trends required by current technological advances:

1. Decentralization and/or classification in implementing the economic units' basic functions, with a priority on projects concerning production and production processes, by means of applications in real time.

2. Generalized use of data centers and the systems for managing them, on the "distributed data center plan." This is done with a structure of the

*Symposium on Data Processing in Preparing Manufacture and Scheduling, Starting and Checking Production, Timisoara 25-27 October 1979 and Symposium on Data Processing Applications in Construction Design and Research, Sibiu 1-2 November 1979.

network type and calls for various levels of responsibility: conceptual and strategic, conceptual as to structure by fragmentation and distribution, administration and current use, and construction and technical implementation.

This means that management is involved on several levels and that the data centers must be constructed independently of the organizational structures they serve.

3. Generalized use of information instruments permitting both a qualitative leap in design and construction and greater labor productivity in all stages of setting up the information systems. These instruments, which are to be supplemented, can be of the following kinds: technical documentation; methods, norms and standards; and program-products: special languages, libraries of programs etc.

4. Typologizing the applications on the level of elementary functions that can be finalized with integrable program-products in packages for general use.

When the diversification provided in the plan to supply the economy with computing equipment in the next few years is provided for, these objectives can and must be undertaken in Romania in view of the priorities placed on national economic development. Growing professionalism in this field will require concentration of responsibility to the beneficiary upon development of technical solutions by supplying "finished systems and applications."

Data Processing for Automatic Control Systems

Automatic control by means of computing equipment and cybernetized control of industrial processes are research fields of great practical and theoretical importance. The start made in Romania in recent years in constructing systems for computer control of industrial processes and in developing computing equipment for the purpose like minicomputers and microcomputers is to be continued, both by supplementing the assortment of computing equipment (process couplers, industrial terminals) and special software, and especially by research and development leading to construction of overall optimal control systems and making better use of the actual potentials of the existing computing equipment for this purpose. Concerning the present state of this field it is sufficient to say that there are a number of very advanced theories and methods of optimal and adaptable control, whereas the traditional equipment (PID regulators, expensive synoptic control panels etc.) is still widely used in practice. Elimination of this temporary discrepancy between theory and practice offers a broad field for research that will surely bring about a notable qualitative leap in the effectiveness of the systems for cybernetized control of industrial processes, auguring a future "golden age" of industrial cybernetics (5).

The studies on construction of systems for automatic, cybernetized control of industrial processes are affected by a number of factors that can be classified as external factors (economic, political and social), reflecting the socioeconomic conditions of our society, and as internal factors which are

peculiar to the field (technological, scientific and methodological). Much of the effect of the external factors is familiar to us and summarized in the program documents approved by the 12th Party Congress, in the sections on development of our society's material base and the necessity of greater labor productivity and the most efficient management of our material resources, for which there is a firm policy of wide-scale transition to cybernetized control of the industrial processes. It is the task of research to clarify in the light of these documents the effects of some additional external factors like the new concepts of labor organization, delimitation of decision making (automated or by humans) etc. and especially the effects of the internal factors, which we shall take up a little more fully below.

As for the scientific and methodological factors, the studies are intended to establish a distinct scientific discipline correlating automation, data processing and operational research, requiring the contribution of interdisciplinary teams.

The studies will emphasize four important fields:

- Optimal and adaptable automatic control of industrial processes with minicomputers and microcomputers in distributed, classified structures;

- Multiple level control of overall systems of large size;

- Automatic, integrated control of the production systems;

- Industrial robotics [robotica].

The theories and techniques that are already researched or being perfected, like the games theory, the systems theory (including the approach through the theory of "fuzzy" systems), multiple criteria rationalization etc., will be widely applicable within these systems.

The studies will also emphasize three essential aspects of the automatic control systems:

- Integration of the human element in the automatic control system;

- Flexibility and adaptability of the automatic control systems;

- Safe operation of automatic control systems.

From the standpoint of integrating the human element in the automatic control systems, the studies are oriented simultaneously toward completely automated and informed [informatizate] systems and toward control systems that include computer-assisted human decisions. The two approaches are not incompatible and have different fields of application.

The studies concern two important problems in connection with the completely automated and informed control systems: (a) correlation of the overall

structures for multiple level control and (b) satisfaction of the requirements for operating safety.

As regards correlation of the automatic control structures, the studies concern determination of the control levels, the number of command units on each level, definition of each command unit's tasks, transfer of information among levels, etc. The solutions will have to allow for the nature of the controlled processes, the methods of control (automatic) used, and the necessary equipment (basic hardware and software), including considerations of cost, reliability and technical performances.

The problem of meeting the requirements for safe operation of a controlled system-control system assembly is becoming increasingly important and even decisive in some applications, due either to the characteristics of the controlled system (the national power system for example) or to the structural complexity of the automatic control system, which makes it practically impossible for a man to take over control in case any failures occur. While we now have certain techniques to compensate for disturbances or failures that modify parameters, such as adaptable control or those based on a sensitivity analysis, remedies for structural disturbances (of the controlled system or the control system) must also be studied and developed that will ensure stability of the impaired system and even minimize deterioration of the performances.

In a considerable number of data processing applications for management and especially in those for economic administration of the units, completely automated systems probably cannot be constructed very soon, chiefly because of the present lack of mathematical models and suitable methods. The procedure for these systems will still be to include the human decision-making element at various points, within classified structures, and on several levels. The information systems will assist these human elements in making the decisions and contribute to implementation of the decisions. In the next period the studies in this field will be directed toward a system solution that appears to be promising, namely transmission of a series of possible solutions to each decision-making element on a given level, solutions compatible with the local restrictions and prepared by an immediately higher level on the basis of a simplified mathematical model and given reference magnitudes, a series of solutions from which the human decision maker will choose one of the alternatives on the basis of a mental model of his own allowing for the temporary disturbances as well. Qualitative mathematical simulation will prevail in this approach, relying on the "fuzzy" systems' methods of description and analysis.

Physical construction of integrated systems for production management and automated control of industrial processes and equipment was made possible by the appearance of miniprocessors and microprocessors and of specialized terminals of the industrial type. Studies of construction of information systems in real time (as distinguished from the "batch" system) are being intensified for this purpose, and they can solve the major problems of scheduling, regulating and checking production, administrating the stockpiles and

supplying each section or shop. They are directly accessible to the productive workers in the production flows, at their places of work, involving them further and giving them a greater incentive (6). This requires a considerable planning and development effort on behalf of both information systems in real time and suitable programs and equipment, especially specialized industrial terminals, with use of microprocessors.

The technological factors that will affect studies on the subject of automatic control information systems equally apply to the main systems that will be controlled, to the technical means of processing the data, to the elements collecting (translating) data, and to the executive components for intervention in the course of the processes.

The fields of application of the developed automatic control systems will be extended from the continuous processes to the intermittent production processes and to systems of the environmental type and those for town planning, transportation, power engineering etc., where they will have an increasing effect upon the members of our society. Note that thanks to the microprocessors automation will be better integrated in the desired optimal structure of the controlled processes, and the automatic control systems will cease to be "grafted" from without. Data processing equipment like minicomputers, microcomputers and especially microprocessors will permit overall structures of automatic control systems based on distributed and interconnected computation elements. Measures must be studied and developed in the field of distributed systems to make such automatic control systems a reality. Research and development are also needed to perfect the means of man-machine dialog and of adequate presentation of the data to the human operator.

As for the special devices pertaining to the automatic control systems, there is a need of developing reliable precision translators for some of them (especially in the case of the analyzers), with local numerical processing of the signals by means of microprocessors.

But Romania's accomplishments in this direction must be diversified and supplemented. For instance development and approval of various types of modules for coupling as a process of the PIC 18 microcomputer and the CORAL 4000 and I-100 (supplementing the ECAROM process) minicomputers are most urgent, as well as development and approval of the biprocessor variant for the MC 18 microcomputer, delivery on demand by the Electronic Computers Enterprise of operational modules of PIC 18 microcomputers and the CORAL 4001 minicomputer for their "incorporation" in more complex control systems or automation equipment, and manufacture of "display" terminals of the industrial type.

Industrial robotics, a new field of automation, will require the use of new and perfected translators for collecting images, sounds, ultrasounds etc. and for generalizing one type of executive component, namely the manipulator as a special accessory of an overall automation assembly.

/No 2, 11 Jan 80 pp 21-23/

/Text/ Information Programs and Data Centers

The preparation of the programs for electronic computers is vitally important to research and development in data processing. A considerable gain in labor productivity, which is still rather low in this sector, is an objective of first priority. Research will be intensified in the following fields: (a) development of new methods of computer-assisted technical analysis and design of information systems, (b) new ways and means of interactive preparation of the programs (for Felix C-256/512 computers and especially for Felix C-8000 computers and minicomputers), (c) methods and associated program packages for automatic testing of the program-products, and (d) utility programs for administration of the data centers, the transactional operating system and the interconnection between computers and minicomputers, as well as compilers for some of the most developed programming languages for "on-line" processing in real time. This research and development are going on in the ICI /Central Institute for Data Processing/ (including the Regional Electronic Computer Centers), the ITC /Research Institute for Computer Technology/ and the IPA /Automation Research and Design Institute/ and some institutions of higher education.

Alongside the research and development effort to adequately equip the preparation of programs, another effort is needed in both design and organization to develop and generalize the engineering techniques of programming and to place program preparation (7) on a real industrial basis that will both minimize the programming efforts throughout the national economy and meet the requirements for rational satisfaction of the beneficiaries of information systems. This requires not only development of engineering methods of programming but also an effort toward technical-economic substantiation of program production, planned activity and standardized work norms for programming and for approving and maintaining the program-prpducts.

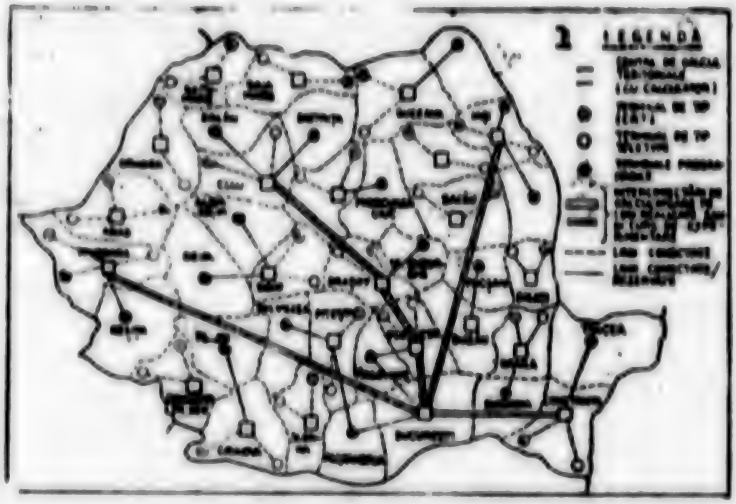
The data centers and systems of data banks are of primary importance in the developed information systems. In addition to formation of the data banks by current methods, interesting developments are to be expected in this field both in organization of the data centers and in some hardware structures, combining microprocessors and sections with large memories, to the point of building computers specially designed for the data banks.

Distributed Data Processing and Computer Networks

Distributed data processing is required by the integration of computers with the communication systems and by the great progress made in these fields and in microelectronics. This will mark the beginning of a new stage in the use of computers that can be characterized as follows:

- The step from data processing for management to data processing for society, with a much broader social base;

- The step from data processing for economic development and growth to data processing for the individual's requirements in the most varied activities, including his private life.



1. Legend:
   Regional computing centers (with computer)
   Terminal of the CRT type
   Terminal of the teletype type
   Programmable terminals
   Interconnections of computers on lines constructed or under testing
   Connected lines
   Connected or reserved lines

In general distributed data processing can be defined by three characteristics: equipment, data (with the associated memory) and the control necessary to use the equipment and convey the data. The concept of distributed data processing depends upon expanded and generalized teleprocessing and construction of computer networks.

The Central Institute for Management and Data Processing and the Regional Electronic Computer Centers have already made program-products and tests for the following purposes:

- Use of character-type terminals (like TTY and display-teletypes);

- Use of message-type terminals;

- Use of programmable terminals on commutated and leased lines;

- Interconnection of computers of the local and long-distance Felix C-256 type, on leased lines;

- Interconnection of minicomputers with local and long-distance Felix C-256 computers, and interconnection of two minicomputers;

- Interconnection of several minicomputers and Felix C-256/512 computers is being tested as a preliminary stage in building the national computing network.

The map presents a general picture of the use of the various types of terminals and of the said interconnections, including all the regional centers and offices and the Central Institute for Management and Data Processing. The study on construction of a high-speed data transmission network with commutation of packages is in the final stage.

The future National Computer Network (RENAC) will make several objectives possible:

1. Use of the computing capacities hooked up in the network by any individual user from a terminal located at any point in Romania where there is a telephone set, but with authorized access;

2. Use of geographically distributed data centers, for various computers in the network, which will supply the information systems with data for management on the regional and macroeconomic levels;

3. Use of unified computing resources hooked up to the network by users stationed at a distance, anywhere in Romania;

4. Use of data centers specializing in various activities, such as documentary information, medicine, meteorology etc.

Accomplishment of these objectives requires expanded research and experimentation accompanied by development of the plans for use of these systems in various fields according to the requirements for Romania's socioeconomic development.

Data Processing in Technical and Technological Design

Data processing is an increasingly necessary tool of design, both for enhancing labor productivity and for planning and designing new products optimally with lower material and energy inputs while providing for good performance. To meet these requirements it is planned to develop the following activities:

- Development of languages readily assimilated and used by designers in various fields;

- Development of program-products permitting use of the graphic accessories and terminals characteristic of computer-assisted design;

- Development of planning and formation of program libraries and data centers characteristic of the various fields and sectors.

These activities will also be supported in the next few years by priority supply of minicomputers and terminals to the main research and design institutes in all economic sectors, the technological departments in the

institutions of higher education, and the collectives for research, development and design attached to the big enterprises and industrial centrals. On the basis of the experience acquired in construction research and design in the design institutes' collaboration with some regional electronic computing centers, a major role is planned for these centers in meeting the requirements for other fields too, providing for more efficient use of special equipment on the county level, especially of digitizers and plotters /ploters/.

Conditions are being created for major changes in design work in 1981-1985, and data processing is helping to form design systems and components of more comprehensive technological systems for the various sectors of the national economy. Technology as a system is being accomplished not only locally but also on a national scale (8), and data processing and automation have an essential part to play in this.

Artificial Intelligence

Although some works and studies on the subject of artificial intelligence have been prepared in the Central Institute for Management and Data processing and elsewhere in Romania, it is now a question of more extensive research and activity in this field. Since we are behind other countries, it is urgent for us to choose the formal languages in which we shall prepare the information programs for artificial intelligence. First we must choose a general language like LISP or SAIL, since we do not think we have time to develop an original language, although research on this will continue. Undoubtedly we shall also need specialized languages adapted to certain types of industrial applications of artificial intelligence. In 1980 we intend to make a study in the Central Institute for Management and Data Processing to define our policy on languages for artificial intelligence and data processing for robotics. We must begin at once to develop compilers for these languages so that they can be used both for Romanian minicomputers and for microprocessors. Nor can we rule out the possibility of needing special machines for the languages in general use.

Studies of natural language are basic to data processing and artificial intelligence. As a main problem of artificial intelligence, natural language requires studies in collaboration with mathematicians, linguists, psychologists and neurobiologists. We know from the start that natural language, being dependent upon a living mechansism, the human brain, cannot be entirely comprised in any inanimate technical system. But we also know that a great deal of natural language is subject to processing in information systems. However we must not go so far as to impose upon man the natural language that is accepted by information systems and artificial intelligence because we would dry up his creativity, not only literary and poetic but also scientific, technological, living and social.

The studies on artificial intelligence will take up two other broad subjects: (a) representation of reality and solution of problems in relation to the represented reality, and (b) formation of the data centers and programs that form the model of the represented reality or the model of the world in the

terminology of artificial intelligence. There is a wide variety of methods of solving problems that we must determine and apply. On the other hand the methods of representing reality are much more delicate but offer a broad field for imagination and invention. Representation and resolution are closely related, and the studies in these fields are of outstanding importance. The solution of a problem becomes a course of action in the reality approached, while the easier solution to fulfill a given task or to obtain an intelligent and useful response with less processing and in a shorter time depends to a great extent upon the method of representation.

The problems of the model of the world, or of the reality represented in order to solve problems intelligently, also include study of the methods of representing knowledge, intelligent memory, condensation of data processing, etc.

The studies on artificial intelligence and robotics as well also include the problems of artificial sight and comprehension of speech. The problems are different for speech letter by letter and word by word or for the flow of speech, the latter having to do with artificial intelligence and natural language. In the field of artificial sight, which is closely related to the problems of recognition of configurations (forms), and also in the field of speech comprehension and voice synthesis there is need of collaboration with research collectives in education and in electronics and with the computer centers that are beginning to have such interests.

The extent of the problems in connection with artificial intelligence can be seen when we also consider the problems presented by data processing for robotics. There is need of better labor organization on the national level, to which the Central Institute for Management and Data Processing can contribute because it is so organized itself, on the principle of encouraging and concentrating on the values that produce good results.

Data Processing for Robotics

The provisions in the Directives of the 12th Party Congress on industrial robotics set standards for the development of industrial robotics in Romania, a field combining artificial intelligence, microelectronics and mechanical technology. There are also robots without artificial intelligence, and data processing for robotics emphasizes:

- Use of systems of artificial intelligence programs for robots of a superior generation;

- Information substructure of flexible production cells with use of robots and other modern equipment.

In the field of industrial robotics in Romania, projects have been started at the Central Institute for Machine Building in its research units for mechanical technology, automation and computing equipment and in the respective departments in higher technical education. The Central Institute for Management and Data Processing is developing collaboration with these units in order to define the objectives from the start and to determine the division and resolution of the tasks.

The policy of using robots in manufacture of metal parts has been confirmed, and as we saw in the first part of this article, a priority on the cold sectors and the labor-intensive sectors in general has been ordered. These sectors need somewhat more powerful robots, or robots with hydraulic command.

Pneumatic or electric drives are preferred for low-power robots, and the electric ones are gaining ground. Historically the latter robots were developed to handle small machine parts, to grip and place these parts. Now they are are also made for assembly operations, with positioning tolerances of 0.1 mm, and used for command and control with one microprocessor for each degree of latitude (for example five microprocessors for five degrees of latitude) and one microprocessor to control the other microprocessors used. Therefore the robot can function only on the basis of microprocessors.

We know today that the robot is technologically useless "unless it is adequately integrated in a production system... and that the robot is only a part of a larger system that must be carefully integrated if the robot is to be used efficiently." (9)

Therefore data processing for industrial robotics concerns the whole technological system of a manufacture, with national implications as regards (a) the computing equipment and information programs providing the electronic substructure and data processing of industry, and (b) structural codification of the parts according to their geometric form, quality of the material, quality of the processing etc., as distinguished from the economic codification used in combining computer-assisted design with programmable and flexible automated manufacture. And so it can be said that data processing for robotics has direct implications for some new and important components of the national information system.

Some Problems of Basic Research in Data Processing

Some aspects of basic research in connection with artificial intelligence were mentioned above. Basic research on data processing centers upon the concept of information in its broadest sense and on the level of all human knowledge and the unity of science. Information is related not only to the entirety of the processes with which man and society are confronted but also to the profound aspects of animate and inanimate matter. The automatic and the mental natural with its phenomenology, the formal and the nonformal, the artificial semantic, the formal semantic and the natural semantic, all these relationships offer fertile ground for new basic research. For the time being we have not undertaken organized studies of these problems, but they are objects of extra efforts on the part of our researchers because of the difficulties caused by the problems the planned projects present. These efforts will certainly be expanded along with the development of the projects in the fields of artificial intelligence, data processing for robotics, fuzzy sets /multimi vagi/, simulation, data banks etc.

A new category of basic problems has arisen because we must perform functions demanded by society in a new way, by use of microelectronics and data processing, which was not possible in the past. These problems are in connection

with the architecture and the operational and structural functions of the technical systems in relation to society, the individual and the environment. Since the functions of the technical systems are coming to depend more and more upon computing equipment and information programs supported by the substantive microelectronic structures, this branch of the technical sciences that determines performance of functions was called functional electronics. The purport and content of an approach are extremely broad and rich, going beyond the original scope of functional electronics whereby electronics was seen solely in relation to its own functions. It is a matter of a complete change of viewpoint, proposed in Romania in the last few years and confirmed by stands also taken recently by specialists in other countries. Electronics and data processing will provide useful functions organized in given structures wherein the microelectronic devices integrated on wide and very wide scales will be combined synergetically with artificial intelligence. This is one of the evident trends of the last few years. (10)

New Aspects of Labor Organization

Industrial automation and its new stages of reprogrammable and flexible automation are changing the nature of labor. The traditional organization of labor, called scientific labor organization, is characterized "by a dichotomy between planning (organization) and execution of the tasks... Another chief element of scientific labor organization, both a cause and an effect, is the principle of measurement and of norms: Quantitative methods are developed for recording and determining the basic periods of time for doing the work, which consolidate the system and stabilize the productive individual." (11)

Today we realize that these processes are due to the nature of the essentially mechanical productive forces, which affected the organization of human labor to make it more productive. Labor organization was adapted to equipment devoid of data-processing and automation means, and it adapted man to this equipment. With functional electronics we pursue quite the opposite end of adapting the equipment to man's natural functions by means of electronics. Scientific labor organization with mechanical, uninformed and unautomated equipment confines the individual in a mechanical system in many industrial sectors, a stage becoming outmoded by the transition to the new industrial revolution brought about by microelectronics and data processing. The problems of labor organization under the new conditions will differ from those of the era of purely mechanical equipment. The appearance of flexibly automated manufacturing cells leads to formation of teams of workers whose activity will include a small team to service the automated cell, a team to maintain the equipment, a team to reprogram manufacture, a team to design the new products, etc.

Regarding today's conditions, which are intermediate between the old mechanized industry and the future but near cybernetized industry, a study of the International Bureau of Labor specifies a number of requirements for a new form of labor organization based on a new model of the individual at work (12):

- Close ties between the nature of the individual and his work, with the recommendation to offer workers an increasingly complex working situation;

- Recognition of spontaneous organization, which guarantees a better adjustment of the individual to his work. Note that this is possible only in manufacturing cells with teams of workers that also ensure productivity growth.

- Recognition of the worker's whole personality in the form of a job without artifically delineated tasks and consequently in the form of a complete job that engages his initiative and sense of responsibility;

- Determination of the whole effect of the worker's job and his identification with the whole final product;

- Satisfaction of the worker's natural sociability by group work without any undue organizational hierarchy.

It is evident that under the present conditions only a part of these aims could be accomplished without losing in labor productivity or maintaining the present productivity at best. Therefore the changes in labor organization actually depend upon introduction of the new automated, informed and cybernetised productive forces. The above-mentioned study recognizes that "the connections between technology and the new forms of organization are evident"(13) but it also comments that "it would be wrong to claim that technology rigidly determines the method of organization." (14)

In analyzing the effects of the new technological equipment and data processing upon labor organization, we should note that a process of objectivising production activity is beginning with the appearance of new roles of the individual at work, and it will completely change the data of the labor organization problem.

In the intermediate, most difficult stage the the trend toward objectivizing, especially by means of data processing, may encounter various difficulties such as failure to involve the enterprise management in construction of the information system or all workers in use of data processing.

The role of the enterprise management in constructing the information systems and correlating them with the organizational structures, labor organization and capacities of the unit is an essential one.* As soon as we construct complete information systems in enterprises, with data centers and terminals, and once the technical operation of the system is secured, the enterprise management bears the main responsibility for the usefulness and viability of the information system. An information system operating in isolation from the management will upset the traditional decision-making pyramid of the enterprise, which will hinge upon the computing center or office instead of the enterprise management. (15)

As a matter of fact administrative work itself in all its aspects is beginning to be involved in data processing. The simplest example is the introduction of the data-processing terminal on the enterprise director's table. A study made in the United States shows that managers spend 24 percent of their time

*We know this not only from world experience but also from our own.

on nonmanagerial tasks of a routine type. It is estimated that the bureau data-processing methods that the French call bureaumatics can reduce this time to 6 percent. (16) It is also estimated that up to 90 percent of the decisions the managers make can be programmed and consequently automated. (17)

We can consider bureaumatics one of the new trends in data processing, especially distributed data processing. The Central Institute for Management and Data Processing is preparing a first experiment in electronic mail and processing texts in connection with the electronic computer network.

Successful introduction of the new information systems requires training of all those who normally come in contact with the data-processing terminals, workers, foremen, technicians, engineers, economists and other specialists.

There is beginning to be a need of generalized education in data processing, a minimum education that will make the subject accessible, familiar and psychologically accepted. All workers will be prepared in this way for the next stages of cybernetized production and the new methods of labor organization will be furthered. The organization produced by the first industrial revolution has not undergone essential changes in the stage of the present scientific and technical revolution, but they will be made in that of the second industrial revolution. Information is now becoming neutral from the standpoint of organization (18) because distributed data processing has made it possible to adjust the information system to a given organization and not the reverse. Organization itself is becoming more flexible under new requirements.

The foregoing considerations suggest subjects of study and research on the problems of organization in correlation with the effects of introduction of data-processing equipment and automation and the necessity of distinguishing stages in their effect upon organization.

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